Abstract

GALILEO MISSION PLANNING FOR LOW GAIN ANTENNA BASED OPERATIONS

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The Galileo ~~Mission~~ mission operations concept is undergoing substantial redesign while the spacecraft is on its way to Jupiter, necessitated by the deployment failure of the High Gain Antenna. The new design applies state-of-the-art technology and processes to increase the telemetry bandwidth available through the Low Gain Antenna and to increase the information density of the telemetry. This paper describes the mission planning process being developed as part of this redesign. Principal topics include: a brief description of the new mission concept and anticipated science return (these have been covered more extensively in earlier papers), identification of key drivers on the mission planning process, a detailed description of the process and its implementation schedule, a discussion of the application of automated mission planning tools to the process, and a status report on mission planning work to date.

Galileo enhancements include extensive reprogramming of on-board computers and substantial hardware and software upgrades for the Deep Space Network (DSN). The principal mode of operation will be onboard recording of science data followed by extended playback periods. A variety of techniques will be used to compress and/or edit the data both before recording (to conserve space on the tape) and during playback (to increase the information density of the downlink). A small highly-compressed real-time science data stream will also be important. The telemetry bandwidth will be increased using advanced coding techniques and advanced receivers which both increase sensitivity and facilitate extensive arraying of DSN antennas.

Galileo Mission planning for orbital operations now involves partitioning of several scarce resources at progressively greater levels of detail. Particularly difficult are division of the telemetry bandwidth among the many users (eleven instruments, radio science, engineering monitoring and navigation) and allocation of space on the tape recorder at each of the planned ~~eleven~~ ten satellite encounters. The planning process is complicated by uncertainty in performance of the DSN modifications and the non-deterministic nature of the new data compression schemes.

This paper describes the mission planning process in detail. Key steps include quantifying resource capabilities to be allocated, prioritizing science observations and estimating resource needs for each, working inter-and intra-orbit trades of these resources among the Project elements, and planning real-time science activity including detailed planning for buffering "real-time" data during telemetry outages.

The paper also describes the schedule for the mission planning process, most of which is to be completed prior to Jupiter arrival (December 1995). The first major activity, a high level, orbit-by-orbit allocation of resources among major science objectives, has already been completed; and results are illustrated in the paper.

To make efficient use of limited resources, Galileo mission planning will rely on use of automated mission planning tools capable of dealing with interactions among time-varying downlink capability, real-time science and engineering data transmission, and playback of recorded data. The paper describes adaptation of a new generic mission planning tool for this purpose.